

In re Application of:  
Landau

Issued: July 17, 2001

For: ELECTRO-CHEMICAL  
DEPOSITION SYSTEM AND  
METHOD OF ELECTROPLATING  
ON SUBSTRATES

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Group Art Unit: N/A

Examiner: N/A

MAIL STOP REISSUE  
Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

I hereby certify that this correspondence and the documents referred to as attached therein are being deposited on 07/17, 2003 with the United States Postal Service in an envelope as "Express Mail Post Office to Addressee," mailing label No. EV331233581US addressed to: MAIL STOP REISSUE, Commissioner for Patents, P.O. Box 1450 Alexandria, VA 22313-1450.

07/17/03  
Date

Signature

Dear Sir:

Prior to examination of the above styled application in reissue, Applicant requests that the reissue application be amended as follows:

Please replace the paragraph at column 5, line 38 with the following paragraph:

Figures 1A-1E are cross sectional views of a dual damascene interconnect in a dielectric layer illustrating a metallization technique for forming such interconnect.

Please replace the paragraph at column 9, line 24 with the following paragraph:

The substrate holder 44 is positioned above the container body 42 so that the substrate plating surface 54 of a substrate faces the opening of the container body 42. The substrate holder 44 is disposed on an outer ring 66 that is connected to the top portion of container body 42. An insulating O-ring 68 is disposed between the substrate holder 44 and an outer ring shoulder 66. Preferably, the substrate holder 44 includes a

beveled lower portion 70 that corresponds to a beveled upper edge 72 of the container body 42 which together form at least a partial circumferential outlet 74, from about 1 mm to about 30 mm, between the substrate holder 44 and the container body 42 for electrolyte flow therethrough. The outlet 74 preferably extends around the perimeter of the container body and cover, but it may alternatively be segmented as shown in Figure 3 to provide electrolyte egress corresponding to the spaces adjacent the segmented auxiliary electrodes 84. The width of the outlet can be adjusted by raising or lowering the substrate holder 44 relative to the upper surface of the container body to accommodate different plating process requirements. Preferably, the width of the outlet is between about 2 mm and about 6 mm. The outlet 74 preferably has a narrow and sloped egress to enhance the outward flow of electrolyte and to minimize stagnant circulation corners where bubble entrapment can occur. As shown in Figure 2, the outlet 74 provides electrolyte egress at about a 45° downward slope. The electrolyte egress outlet 74 continues through a space 76 between the inner surface of the outer ring shoulder 66 and the outer surface of the container body 42. Then the electrolyte flows through one or more outlets 78 connected to a pump (not shown) and recirculates through the electroplating cell 40 through inlet 50.

Please replace the paragraph at column 15, line 64 with the following paragraph:

For a pre-determined grain size, a current pulse comprising a higher negative current density for a short time (between about 50 mA/cm<sup>2</sup> and about 180 mA/cm<sup>2</sup> for about 0.1 to 100 ms) is applied to nucleate an initial layer of copper deposits followed by a constant current density applied for a long interval (between about 5 mA/cm<sup>2</sup> and about 80 mA/cm<sup>2</sup> for up to a few minutes) to continue deposition. The length of the deposition interval can be adjusted according to the deposition rate to achieve the desired deposition thickness over the substrate surface.

Please replace the paragraph at column 17, line 40 with the following paragraph:

An electrolyte having a high copper concentration (e.g., >0.5M and preferably between 0.8M to 1.2M) is beneficial to overcome mass transport limitations that are encountered with plating of sub-micron features. In particular, because sub-micron